

STS 112/9A: Assessment of Air Quality in the International Space Station (ISS) and Space Shuttle Based on Samples Returned in October 2002

The toxicological assessments of grab sample canisters (GSCs) and formaldehyde badges returned aboard STS-112 are reported. Analytical methods have not changed from earlier reports. Surrogate standard recoveries from the GSCs were 83-126%. One GSC sample leaked after acquisition because of a bad valve. Recoveries from lab and trip controls for formaldehyde analyses ranged from 86 to 89%.

The two general criteria used to assess air quality are the total-non-methane-volatile organic hydrocarbons (NMVOCs) and the total T-value (minus the CO₂ and formaldehyde contributions). Control of atmospheric alcohols is important to the water recovery system engineers; hence total alcohols (including acetone) are also shown for each sample. Because formaldehyde is quantified from sorbent badges, its concentration is listed separately. These indices of air quality are summarized below (OFP=octafluoropropane or Freon 218):

| <u>Sample</u> | <u>Date</u> | <u>NMVOCs - OFP</u> | <u>OFP</u> | <u>T Value^a</u> | <u>Alcohols</u> | <u>Formaldehyde</u> |
|-----------------------|-------------|--|----------------------|----------------------------|----------------------|--------------------------|
| <u>Location</u> | | (mg/m ³) | (mg/m ³) | (units) | (mg/m ³) | (mg/m ³) |
| Lab GSC | 6/20/02 | 10.2 | n/a ^b | 0.65 | 6.1 | 0.059 |
| FGB GSC | 6/20/02 | 12.1 | n/a | 1.13 | 7.5 | ns ^c |
| SM GSC | 6/20/02 | 14.1 | n/a | 1.25 | 8.4 | 0.031 |
| Lab GSC | 7/17/02 | 10.2 | n/a | 1.15 | 5.3 | 0.064 |
| FGB GSC | 7/17/02 | 9.5 | n/a | 0.97 | 6.2 | ns |
| SM GSC | 7/17/02 | 10.2 | n/a | 0.98 | 6.1 | 0.038 |
| Lab | 8/06/02 | <i>sample invalid due to leaky valve</i> | | | | 0.062 |
| SM | 8/06/02 | <i>sample not taken due to 9A launch delay</i> | | | | 0.025 |
| Lab GSC | 9/10/02 | 7.3 | n/a | 0.83 | 3.6 | 0.065^d |
| SM | 9/10/02 | <i>sample not taken due to 9A launch delay</i> | | | | 0.025 ^d |
| Shuttle Preflight | 10/02/02 | 0.5 | n/a | 0.02 | 0.1 | ns |
| Shuttle Middeck | 10/18/02 | 8.2 | n/a | 0.43 | 5.8 | ns |
| Acceptable Guideline: | | <25 | 85000 | <1 | <5 | 0.050 |

^a Formaldehyde and CO₂ not included in T calculation.

^b n/a = not in analysis plan

^c ns = no sample

^d Possible mix up in sample locations makes these data uncertain

The table shows that the air quality in general was acceptable for crew respiration; however, certain values shown in bold require further explanation. The T values that were slightly above the guideline of 1.0 were due to relatively high concentrations of methylcyclsiloxanes in the samples. These compounds primarily cause injury to the respiratory system (not irritation) and reproductive toxicity. Thus, they act independently of other compounds comprising the T value and when their contribution is removed, each T value falls below 1.0. The formaldehyde values of 0.06 mg/m³ found in the Lab samples are cause for concern and are under review by the Environmental Contingency Action Core Team. A comparison of the intermodular concentrations listed in table 1(enclosure) for the following pollutants suggests excellent mixing: methanol, acetaldehyde, acetone, dichloromethane, ethyl acetate, n-butanol, and xylenes.

Enclosures

1: [Analytical Results of STS-112/9A GSC Samples](#)

2: [T Values of STS-112/9A GSC Samples](#)